Tsunehiko NISHIKAWA* & Koji ITO**: **The chromosome numbers of *Adonis amurensis* Regel et Radde (sensu lato) of northern Honshu*****

西川恒彦*・伊藤浩司**: 本州北部産フクジュソウの染色体数

Gorovoy and Gurzenkov (1969) published their opinion that Japanese "Fukujyuso" is distinctly different from the Far Eastern *Adonis amurensis* not only in morphological characters but also in the chromosome number. According to them, the most prominent differences could be found in the chromosome number and in the ratio of sepal length to the petal length; the chromosome number was n=12 and the petals were usually longer than the sepals in the Japanese plants, while in the continental *Adonis* plants, the chromosome number was n=8 and the petals were usually equal to or a little shorter than the sepals. In addition, they made a nomenclatorial correction on the Far Eastern *Adonis: A. amurensis* Regel et Radde should be retained for the continental *Adonis* plants with n=8; *A. ramosa* Franch. is the correct name for Japanese *Adonis* plants with n=12 chromosome number. Kitagawa (1971) accepted their opinion and retained the Japanese name "Fukujyuso" for *A. ramosa* Franch., newly proposing "Ichige-Fukujyuso" for *A. amurensis* Regel et Radde.

In our previous paper (1978), two sorts of the somatic chromosome numbers were reported to *Adonis* plants of Hokkaido: 2n=16 and 2n=32. As we did not observe the chromosome number of *A. amurensis* (s.l.) of Honshu at that time, we could not refer to the discrepancies between our counts and other counts of n=12 (Takamine 1916, Ishikawa 1916), n=20 (Sugiura 1931) and 2n=24 (Kurita 1955). In the present paper, we report our results of observation on certain morphological characters in relation to the chromosome numbers for plants of *Adonis* with 2n=16, 24 and 32 in northern Honshu.

* Biological Laboratory, Asahikawa College, Hokkaido University of Education, Asahikawa. 北海道教育大学旭川分校生物学教室.

** Graduate School of Environmental Science, Hokkaido University, Sapporo. 北海道大学大学院環境科学研究科.

*** Contribution from the Herbarium of SAPT (Faculty of Agriculture, Hokkaido University, Sapporo).

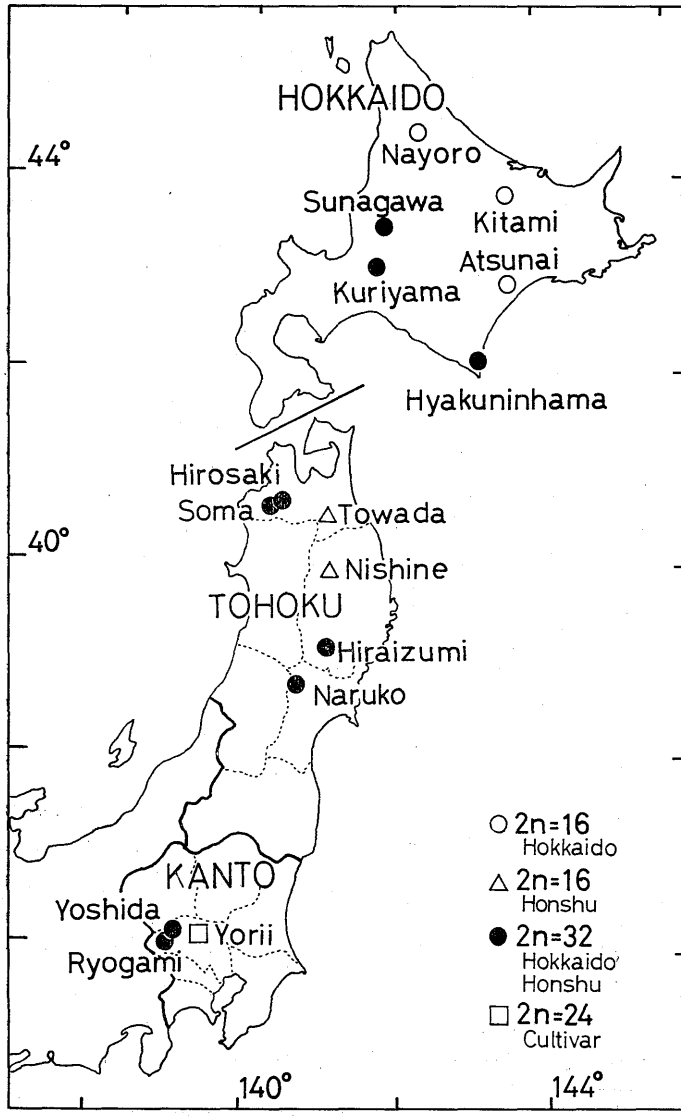

Fig. 1. Distribution map of *Adonis amurensis* (s.l.) with 2n=16, 32 and 24 in Hokkaido and northern Honshu.

Materials and Methods

Living plants were collected from 9 localities in northern Honshu, namely, Tohoku- and Kanto-District in March and April in 1978 as shown in Fig. 1, and were transplanted at Asahikawa, central Hokkaido. For the determination of the somatic chromosome number the ovules were employed. They were treated with 8 hydroxyquinoline (0.002M) for 4-5 hours and fixed in a 3:1 mixture of alcohol and acetic acid for about 5 minutes, and were transferred to 1N HCl at 60°C for 1 to 2 minutes thereafter. Pollen fertilities were estimated by staining pollen grains from mature anthers in a cottonblue-lactophenol solution (Tateoka 1973). The vaucher specimens were deposited in SAPT.

Observations

1. *Somatic chromosome number* Fig. 2 shows that somatic chromosome numbers are proved to be 2n=16, 24, and 32 respectively. The chromosome number of 2n=16 was found in plants collected from Towada (Aomori Pref.) and Nishine (Iwate Pref.). The Number of 2n=32 was found in those collected from Hirosaki and Soma (Aomori Pref.), Hiraizumi (Iwate Pref.), Naruko (Miyagi Pref.), Ryogami and Yoshida (Saitama Pref.). The number of 2n=24 was found in plants of a cultivar *Fukujyukai* obtained from Yorii (Saitama Pref.).

The results show that *Adonis* plants with 2n=16 seem to be limited to

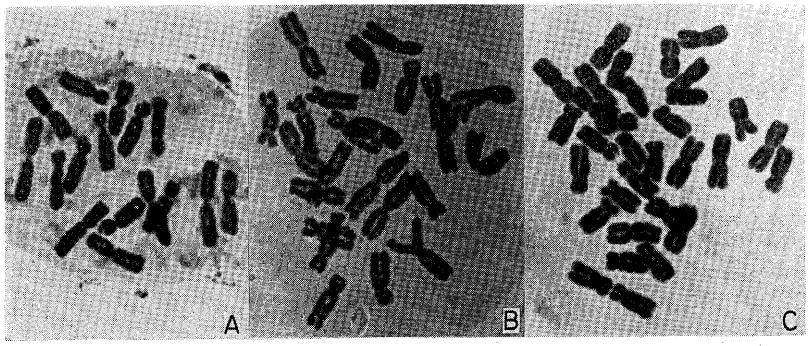

Fig. 2. Photomicrographs of somatic chromosomes of *Adonis amurensis* (s.l.). A: 2n=16 (Towada, Aomori Pref.). B: 2n=24 (Yorii, Saitama Pref.). C: 2n=32 (Naruko, Miyagi Pref.). All ×1500

NE part of Tohoku District and Hokkaido in their range, while those with 2n=32 seem to be wider in range, being found throughout Hokkaido, Tohoku District and Kanto District. It is noteworthy that the chromosome number of 2n=24 was counted in only a cultivar race, and not in wild races.

2. *Number of flowers per stem* Five hundred and seventeen living plants were used to investigate flower number borne on one stem. Table 1 shows that all plants with 2n=16 collected in Hokkaido bear a single flower on a stem, while all plants with 2n=16 collected in Honshu bear three or more flowers. This means that there are two different cytological races within *Adonis* populations of Japan, even though the chromosome number is 2n=16.

Most of the plants with 2n=32 bore a single flower but a few of them bore more flowers in Honshu as well as in Hokkaido. In this case no distinguishable cytological races are likely to be recognizable; the *Adonis* plants with 2n=32 belong to the same cytological race of Japan. A cultivar race, *Fukujyukai*, with 2n=24 usually showed three or more flowers on a stem. This cultivar shows a similar trend to the Honshu plants of *Adonis* with 2n=16 in its multi-flowering.

3. *The relation of sepal length to petal length* The difference between sepal length and petal length was shown in two ways; one is the ratio of the former to the latter, and the other is the substracted figures of the former from the latter. Figs. 3 and 4 show that the Honshu plants with 2n=16 have obviously longer petals than the sepals. Both the plants with 2n=32 and the Hokkaido plants with 2n=16 show the same trend and have a little longer or

Tab. 1. Number of flowers per stem.

Localities	2n	No. of plants	No. of flowers per stem							
			1	2	3	4	5	6	7	8
Hokkaido	16	51	51	0	0	0	0	0	0	0
Honshu	16	23	0	0	7	7	4	4	0	1
Hokkaido	32	259	227	18	10	4	0	0	0	0
Honshu	32	166	155	6	4	1	0	0	0	0
Honshu (Cultivar)	24	18	0	0	4	8	5	0	1	0
Total		517	433	24	25	20	9	4	1	1

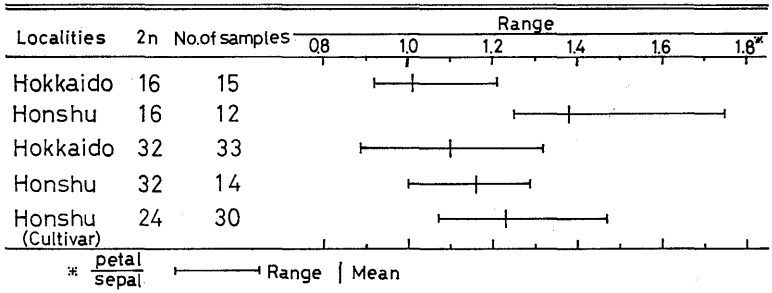

Fig. 3. The range of the ratio of petals to sepals.

shorter petals than the sepals. In any way, Fig. 4 which shows the substracted difference between sepal length and petal length expresses more evidently a definite trend of longer petals in the Honshu plants with 2n=16 than Fig. 3 shown by the ratio of sepal length to petal length.

4. *Number of petals and sepals* Table 2 shows that in the plants with 2n=16 the number of petals and sepals is not so numerous as that in the plants with 2n=32 and 24. In spite of this, it should be noticed that the Hokkaido plants with 2n=16 have more petals and sepals than the Honshu plants with 2n=16. In the former, petals range 11 to 20 and this range of the petal number covers the range from 15 to 20 mentioned in the original description of *Adonis amurensis* Regel and Radde.

5. *Shape and colour of sepals and petals* All plants with 2n=16, 32 and 24 showed that the petal was usually elliptic, but the sepal of 2n=16 plants was somewhat different from that of 2n=32 and 24 plants; in the former the

Tab. 2. Number of petals and sepals.

Localities	2n	No. of samples	No. of petals	No. of sepals
Hokkaido	16	46	11—14.2—22*	6—8.5—12*
Honshu	16	39	10—12.9—15	5—5.1— 7
Hokkaido	32	102	9—13.0—19	5—7.2—10
Honshu	32	16	11—13.9—15	5—6.6— 8
Honshu (Cultivar)	24	37	14—16.0—19	5—5.8— 8

* This means Min.—Mean—Max. (in number)

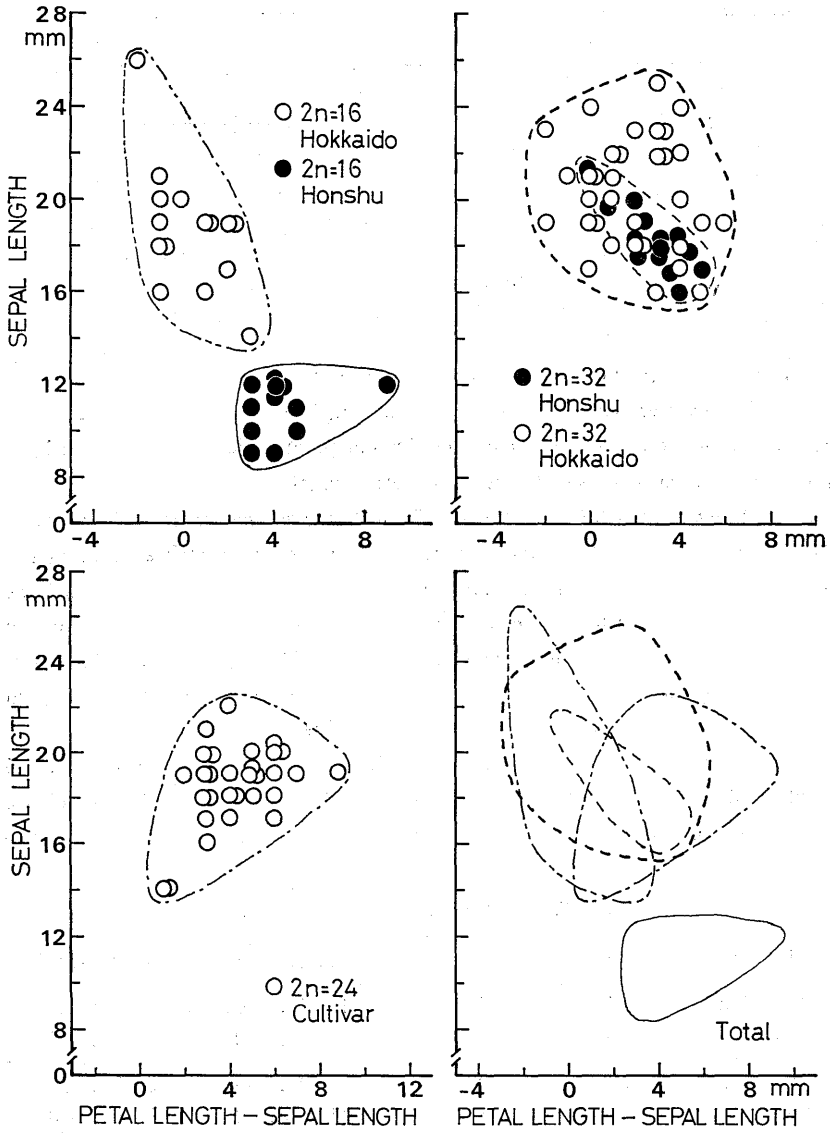

Fig. 4. Scatter diagram showing the relationship of "petal length minus sepal length" to "sepal length".

sepal was rhombic to rhombic-oval; in the latter elliptic to oval in outline.

In all plants the petal was *concolor*, which showed yellow both on the inside and outside of petals. While the sepal was *discolor*; in the 2n=16 plants they were pale green inside and dark green outside, and in the 2n=32 and 24 plants they were yellow on the inside and dark purple with a narrow yellow margin on the outside.

6. *Size and fertility of pollen grains* Two hundred pollen grains were examined in order to scrutinize the size range and the fertility of pollen grains. As a result, as seen in Fig. 5, pollen grains with 2n=16 plants are generally smaller in size than those with 2n=32, while in pollen grains of plants with 2n=24 it ranges from the lower limit of 2n=16 plants to the upper limit of 2n=32 plants, and the average size is about 30μ.

A distinctive discrimination was found in the pollen fertility between the 2n=16 and the 2n=32 plants, and the 2n=24 plants. As seen in Table 3, in the former two plants the pollen fertility ranges from 92% to 96%, while in the latter plants it ranges to 7%. From the fact mentioned above the cultivar *Fukujyukai* was presumably originated by hybridization.

7. *Hairiness of leaves* The abaxial sides of the leaves was glabrous in the 2n=16 plants, but it was scatteredly hairy or scarcely hairy, or glabrous

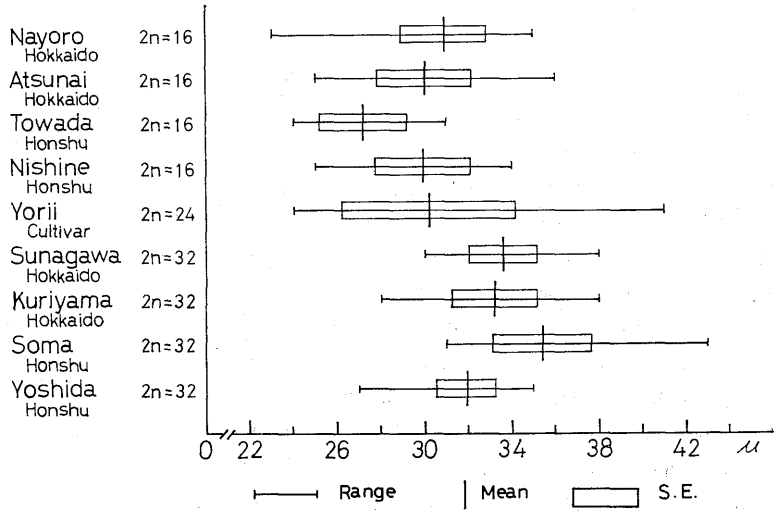

Fig. 5. Size range of pollen grains of *Adonis amurensis* (s.l.).

Tab. 3. Fertility of pollen grains.

Localities	2n	pollen fertility %*
Hokkaido (Nayoro)	16	92
Honshu (Nishine)	16	95
Hokkaido (Hyakuninhama)	32	95
Honshu (Yoshida)	32	96
Honshu (Yorii) (Cultivar)	24	7

* Measured by 200 grains.

in the 2n=32 plants. In comparison with the abaximal side, the adaximal side of the leaves was glabrous in all plants with 2n=16, 32 and 24.

Conclusion

In the present study, we proved three kinds of chromosome numbers of *Adonis amurensis* s.l.: 2n=16, 24 and 32. The 2n=16 plants are distributed in Hokkaido and NE part of Tohoku District, northern Honshu, and the 2n=32 plants are found in Hokkaido, Tohoku and Kanto Districts. However, the 2n=24 chromosome number is counted only in a cultivar *Fukujyukai* and not found in any indigenous plants. We should accept x=8 as the basic chromosome number of the Genus *Adonis* (Darlington & Wylie 1955), and the 2n=24 plants are surely triploid. Moreover, the pollen fertility of the 2n=24 plants is extremely low, only 7%. These facts tell us that the triploid 2n=24 plants are surmised to be originated, either artificially or naturally, in hybridization between the diploid 2n=16 plants and the tetraploid 2n=32 plants.

Based upon the morphological characters, we can make an attempt to distinguish *Adonis amurensis* from *A. ramosa*. It may be said from a viewpoint of the chromosome number that the 2n=16 plants of Hokkaido, and those of N. Honshu belong to the same category. In fact, however, we can find some discrepancies between the Hokkaido plants and the Honshu plants in morphological characters; namely the ratio of sepal length to petal length, flower number borne on a stem, and hairiness of leaves. Subsequently, we think that the Hokkaido plants with 2n=16 are different from those of Honshu, and that they belong to a different cytological race and also to different taxon. As the Honshu plants with 2n=16 provide major morphological

characteristics of *A. ramosa* Franchet which were examined by Gorovoy et Gurzenkov (1969), we have the opinion at the present stage that the 2n=16 Honshu plants differ from the 2n=16 Hokkaido plants, *A. amurensis* Regel et Radde, and are supposed morphologically to be identical with *A. ramosa* Franch. sensu Gorovoy et Gurzenkov, with the exception of the chromosome number n=12. Although some papers (Ishikawa 1916, Takamine 1916, Kurita 1955) have reported the n=12 or 2n=24 chromosome counts, we do not think, at the present moment, that these counts represent the correct chromosome number for wild plants, but we think that these counts were based on the materials of random cultivars, which are assumed to be readily obtained in the laboratories. The correct number of *Adonis ramosa* is 2n=16 which is diploid.

In conclusion, the present study suggests the occurrence of three taxa of *Adonis* plants in Japan. (1) *Adonis amurensis* Regel et Raddle: i) 2n=16, N-E Hokkaido; Leaves pubescent on the abaxial side, a single flower on a stem, and petals nearly equal to the sepals: ii) 2n=32, mainly Central and S. Hokkaido, and N. Honshu; Leaves glabrous, or rarely scatteredly hairy on the abaxial side, mostly a single flower, and petals nearly equal to the sepals. (2) *Adonis ramosa* Franchet sensu Gorovoy et Gurzenkov, 2n=16, NE Tohoku District; Leaves glabrous, more flowers and petals fairly longer than the sepals. (3) A cultivar, presumably originated from the hybridization. 2n=24, with morphological characters often intermediate between *A. amurensis* with 2n=32 and *A. ramosa* with 2n=16, and characterized by remarkably low fertility of pollen grains.

We would like to express our sincere thanks for his kindness of Prof. Dr. M. Kitagawa who prepared for us a copy of Russian literature on *Adonis amurensis*. We also wish to thank Prof. Emer. Dr. H. Hara who gave us critical advice and suggestion on the chromosome number of *A. amurensis*.

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第一報にひきつづき本報では本州（関東，東北）で得られたフクジュソウの染色体数と外部形態についての結果を報告する。供試植物は，十和田，弘前，相馬（青森県），西根，平泉（岩手県），鳴子（宮城県），吉田，両神，寄居（埼玉県）の 9 ケ所から得られ，2n＝16，24および32の染色体数が確認された。

染色体数と外部形態との関係から日本産のフクジュソウについて次のような区分を試みた。(1) *A. amurensis* Regel et Radde キタミフクジュソウ（本田 1939），イチゲフクジュソウ（北川 1971），i）染色体数 2n＝16 で道北，道東に分布し，葉裏に毛を密生し，1 茎に 1 花をつけ，萼片と花弁がほぼ等しい。ii）染色体数 2n＝32 で主として道央，道南および本州北部に分布し，葉は無毛あるいはほとんど無毛。(2) *A. ramosa* Franch. sensu Gorovoy et Guruzenkov フクジュソウ（北川 1971 の意），染色体数 2n＝16，葉は無毛，1 茎に多数花をつけ，花弁は萼片より明らかに長い。東北地方北東部，十和田，西根産のフクジュソウに基づいた。外部形態的には Gorovoy と Guruzenkov の述べている *A. ramosa* に一致するが，染色体数は一致しない。しかし本報では形態的特徴からこのものにあてておく。(3) 園芸品種 福寿海，染色体数 2n＝24，交雑によって生じたと予想される。外部形態は，2n＝32 の *A. amurensis* と 2n＝16 の *A. ramosa* との中間を示す他，花粉の稔性は著しく低く 7% にすぎない。埼玉県寄居産のものに基づく。

□天野鉄夫：**琉球列島植物方言集** 303 pp. 1979 VI，新生図書出版，¥2,500. 沖縄の植物の方言を集めたもので，ことに我々には目新らしいが，じつは存外古い日本語の祖型がまじっていようと思われるものであって，すこしひもどくと興味津々である。たとえばマヤプシキは猫ヒルギの意味だが，ハマザクロの外にメヒルギにもヒルギモドキにもあって，広くヒルギ類に使われたらしい。サキシマハマボウにマヤマキの名があり，これは猫が死ぬとビロウの葉で包んで，この木の枝にかけて風葬する慣わしに由来するというなど。できれば沖縄独特の言葉の由来にももう少しふれてほしかった。索引も和名，学名，方言，方言解説とよくつけてある。まことに貴重な出版物で，著者の多年の御努力に感謝するものである。（前川文夫）